Vegetarian Diet and Cholesterol and Triglycerides Levels

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Objective: Compare levels of triglyceride (TG), total cholesterol (TC), low density lipoprotein (LDL) and high density lipoprotein (HDL) among vegetarians and omnivores.

Methods: Blood samples were collected from 76 individuals – both males and females – separated in four different diet groups: omnivores, lacto-ovo vegetarians, lacto vegetarians, and restricted vegetarians (or vegans). Dosing was done for: TC, LDL, HDL and TG.

Results: Significant difference was reported for TC, LDL and TG levels among the samples. Higher levels were reported by omnivores, with decreased levels for vegetarians as animal products were restricted, with lowest levels having been reported by vegans. Mean and standard deviation for TC were 208.09 ± 49.09 mg/dl in the group of omnivores, and 141.06 ± 30.56 mg/dl in the group of vegans (p < 0.001). LDL values for omnivores and vegans were respectively: 123.43 ± 42.67 mg/dl and 69.28 ± 29.53 mg/dl (p < 0.001). As for TG, those values were 155.68 ± 119.84 mg/dl and 81.67 ± 81.90 mg/dl (p < 0.01). As for HDL level no difference was reported between the samples, but HDL/TC ratio was significantly higher in vegans (p = 0.01).

Conclusion: Vegetarian diet was associated to lower levels of TG, TC and LDL as compared to the diet of omnivores.

Key words: Vegetarian diet, cholesterol, triglycerides.
Methods

A cross-sectional study was carried out. Seventy-six voluntary individuals participated. Most of them were residents in the area the research took place. From those, 22 were omnivores, and 54 were vegetarians. Vegatarians were divided into 3 groups: 19 lacto-ovo vegetarians, 17 lacto vegetarians, and 18 total vegetarians. Recruiting of vegetarians was carried out at vegetarian restaurants, at Seventh-day Adventist Churches, among Hare-Krishna members, and at spiritualistic centers. Newspapers and the University Press Center also released announcements giving possible participants instructions on how to join in.

All participants were sent a letter prior to the study, with explanation on procedures, and risks and benefits involved. They all signed an informed consent, and the study was started after the approval by the Institutional Ethics Committee.

Participants filled out a questionnaire with the following personal information: name, gender, age, type of diet, physical exercise practice, alcohol consumption, smoking Habits, weight and height, the use of statins. Blood was then collected after fasting was confirmed for at least 12 hours. Blood collection was carried out in compliance with standard procedures for blood samples.

Sample analysis was carried out at the Hospital Complex Central Laboratory (Laboratório Central do Conjunto Hospitalar-CHS) through a working agreement with the University. The dosing equipment used for TC, TG and HDL was Dade Behring-Dimension AR, and reactant for Kit Flex Cartriabe was by Dade Behring-Dimension IVD (2 °C a 5 °C).

Concentration measures for TC, TG and HDL were obtained through enzyme biochemical method; LDL concentrations were calculated based on those values and following Friedwald’s formula.

As for statistical analysis, two criteria were used to decide on the use of ANOVA: data with NORMAL distribution and following factors under investigation. The samples are shown to be similar in regard to gender, age, physical exercise and BMI. However, there are significant differences in calculated alcohol consumption (p < 0.001), with higher level among omnivores (4 in 22) as compared to vegetarians (9 in 54, being 6 among lacto vegetarians, 3 among lacto-ovo and none among vegans). The same was shown for the use of tobacco, but only 5 individuals referred use, being 4 in the omnivore group and 1 in the lacto vegetarian group. No reference was made to the use of statins in any of the groups.

Table 2 describes samples of lipid serum level per diet. Significant difference was reported for TC, LDL and TG levels among the samples. Higher values were reported by omnivores, with decreased levels as animal products were restricted, with lowest levels having been reported by vegans. Mean and standard deviation for TC were 208.09 ± 49.09 mg/dl in the group of omnivores, and 141.06 ± 30.56 mg/dl in the group of vegans (p < 0.001). LDL values for omnivores and vegans were respectively: 123.43 ± 42.67 mg/dl and 69.28 ± 29.53 mg/dl (p < 0.001). For TG, those values were 155.68 ± 119.84 mg/dl and 81.67 ± 81.90 mg/dl (p < 0.01).

As for HDL level no difference was reported between the samples, but HDL/TC ratio was significantly higher among vegans (p = 0.01).

Table 3 shows results of regression analysis between lipid serum level, associated factors, and type of diet. Even after adjustment for different confusion variables (as indicated in each model), the three groups of vegetarians reported significantly lower TC, LDL, and TG levels; vegans additionally reported significantly higher HDL/TC ratio. So, variables such as alcohol consumption, physical exercise and BMI were not included, since they were not shown to be statistically significant for data in Tables 1 and 2.
Discussion

Literature gives evidence that vegetarian diet seems to play a role in vascular protection. Results from the present study were similar to those of a number of other studies, which did not, however, investigate the subdivision among vegetarians.

In a study with African Americans, Melby et al. investigated the lipid profile of 66 vegetarians, 56 semi-vegetarians and 45 omnivores. They found that vegetarians reported the lowest TC, LDL, and TG levels. In a study with individuals in Peru, Navarro et al. found the lowest TC and LDL serum concentration among vegetarians. In his doctorate dissertation the same author confirmed lowest TC and LDL levels among vegetarian Adventists in São Paulo.

Harman and Parnell, in their turn, while investigating Seventh Day Adventists in New Zealand, did not find differences between the lipid profile of vegetarians and omnivores, although lipid levels for both groups showed to be lower than what could be observed for the population in general in that country. In the authors’ point of view, life style associated to religion, lower stress levels, no alcohol or caffeine consumption, as well as smoking prohibition could explain low lipid levels in those groups.

While studying 233 vegetarians paired with 233 non-vegetarians and taking into account residence location, sex, age, marital status, body weight, height and occupation, West and Haies have observed that TC was significantly lower in the first group, whereas in the second group TC level increased as meat consumption increased.

In an interesting study on the influence of vegetarian diet on lipid levels, Cooper et al. divided 15 individuals into 2

<table>
<thead>
<tr>
<th>Lipid</th>
<th>Omnivores</th>
<th>Lacto-ovo Vegetarians</th>
<th>Lacto Vegetarians</th>
<th>Vegans</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cholesterol</td>
<td>208.09 ± 49.09</td>
<td>175.32 ± 28.47</td>
<td>164.82 ± 51.00</td>
<td>141.06 ± 30.56</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>HDL</td>
<td>56.23 ± 18.29</td>
<td>55.47 ± 14.61</td>
<td>57.71 ± 14.92</td>
<td>55.67 ± 13.93</td>
<td>0.96</td>
</tr>
<tr>
<td>HDL/Total Cholesterol Ratio</td>
<td>0.29 ± 0.12</td>
<td>0.32 ± 0.09</td>
<td>0.37 ± 0.13</td>
<td>0.41 ± 0.11</td>
<td>0.01</td>
</tr>
<tr>
<td>LDL</td>
<td>123.43 ± 42.67</td>
<td>101.47 ± 28.07</td>
<td>87.71 ± 41.67</td>
<td>69.28 ± 29.53</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>155.68 ± 119.84</td>
<td>93.95 ± 33.43</td>
<td>94.71 ± 62.51</td>
<td>81.67 ± 81.90</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Total Cholesterol</th>
<th>HDL</th>
<th>HDL/Total Cholesterol Ratio</th>
<th>LDL</th>
<th>Triglycerides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacto-ovo Vegetarians</td>
<td>b</td>
<td>-31.41</td>
<td>-4.15</td>
<td>0.009</td>
<td>-22.22</td>
</tr>
<tr>
<td></td>
<td>Cl 95%</td>
<td>-54.09 to -8.73</td>
<td>-13.44 to 5.14</td>
<td>-0.06 to 0.08</td>
<td>-42.80 to 1.64</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.007</td>
<td>0.376</td>
<td>0.793</td>
<td>0.035</td>
</tr>
<tr>
<td>Lacto Vegetarians</td>
<td>b</td>
<td>-39.74</td>
<td>-1.03</td>
<td>0.06</td>
<td>-34.21</td>
</tr>
<tr>
<td></td>
<td>Cl 95%</td>
<td>-63.16 to 16.32</td>
<td>-10.40 to 8.34</td>
<td>-0.004 to 0.13</td>
<td>-55.43 to -12.99</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.007</td>
<td>0.793</td>
<td>0.066</td>
<td>0.002</td>
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<tr>
<td>Vegans</td>
<td>b</td>
<td>-54.14</td>
<td>-1.73</td>
<td>0.07</td>
<td>-44.92</td>
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<tr>
<td></td>
<td>Cl 95%</td>
<td>-77.79 to -30.49</td>
<td>-11.37 to 7.92</td>
<td>0.0004 to 0.139</td>
<td>-66.24 to -23.59</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.000</td>
<td>0.722</td>
<td>0.049</td>
<td>0.000</td>
</tr>
<tr>
<td>r2 of Final Model</td>
<td>0.45</td>
<td>0.20</td>
<td>0.33</td>
<td>0.40</td>
<td>0.32</td>
</tr>
<tr>
<td>Final Model Adjusted for</td>
<td>age, gender and age</td>
<td>Age and smoking habits</td>
<td>age, gender and age</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Omnivore diet was defined as the comparison group. b- regression coefficient; Cl 95% = 95% confidence interval.

Table 3 - Regression analysis between serum lipid levels and associated factors following types of diet *
VEGETARIAN DIET AND CHOLESTEROL AND TRIGLYCERIDES LEVELS

Original Article

5. Centers for Disease Control and Prevention (CDC). Declining prevalence of
4. Rizos E, Mikhailidis DP. Are high density lipoprotein (HDL) and triglyceride
2. Steinberg D, Gotto AM Jr. Preventing coronary artery disease by lowering

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groups: one group followed the regular American diet (with
individuals having a weekly average of 1 egg per day, one
commercial baked good per day, and at least one serving of red
meat per day); the other group was made up of vegetarians.
Participants complied with one of those two types of diets for
three weeks. Then, the groups switched diets, and complied
with it for another three weeks. It was found that vegetarian
diet significantly decreased TC and LDL levels irrespective
of the group, and also that in the vegetarian period calorie
intake was approximately 30% lower. Therefore, cholesterol
reduction could have been a result of lower calorie intake,
rather than abstaining from eating meat. The study is quite
relevant, though, since it excludes the influence of genetic
variables and lifestyle.

Mancilha-Carvalho and Crews conducted a study with
Yanomami Indians. That population has quite a different
lifestyle from the individuals living in the industrialized world.
Their diet is based on local agriculture, including roots,
sweet potato, sugar cane, added by wild fruits and insects.
The Yanomami do not raise animals, and the meat they
include in their diet comes from hunting, and therefore, it is
relatively rare. They have little access to processed sugar,
salt, alcohol, milk and its by-products, and eggs. In the study,
the lipid profile of Brazilian Yanomamis is compared to
American men from studies such as the NHANES (National
Health and Nutrition Examination Survey-1976-80) and LRC
(Lipid Research Clinics Population). When compared to the
Americans in the NHANES study, the Yanomamis reported
lower TC serum levels as compared to Americans – both males
and females. When compared to Americans in the LRC study,
the Yanomamis were found to have lower TC, LDL, and HDL
levels – also both males and females. One interesting aspect
is that blood collection of the Yanomamis was carried out
with no data in the time span between their last meal and
the time of collection.

In our sample, vegans reported significantly lower levels as
compared to omnivores in regard to TC, LDL, and TG, and
significantly higher ratio HDL/TC (Table 2), even after age,
gender and smoking habits had been adjusted (Table 3). As
for lacto-ovo vegetarians and lacto-vegetarians, TC, LDL, and
TG levels have been found to be significantly lower (Table 2
and 3). So, our results point towards the association between
low lipid levels and vegetarian diet - in agreement with the
authors mentioned earlier. However, they disagree with
Cliffton and Nestel, who consider the metabolic component
as determining factor for serum cholesterol levels.

Based on such observations, one could speculate on the
use of vegetarian diet – especially vegan – as coadjuvant
action in preventing or treating dyslipidemias. Nonetheless,
it is important to point out that the present study investigated
vegetarian diet under one single focus - lipids – in a sample
from the general population. Other counterpoints have
been reported, though. Among them, the most common
and the most widely investigated is cobalamin deficiency,
which leads to megaloblastic anemia. Iron deficiency may
also be associated, thus masking the megaloblastic anemia
condition. There are also reports of higher prevalence of
hypospadia and higher levels of homocysteine among
vegetarians as compared to omnivores. Additionally,
genetic hypothyroidism cases have been reported in
children breast fed exclusively with vegan mothers’ milk
(in regions where not all salts are iodated), as well as
bilateral optical neuropathy, severe sight impairment, and
other visual problems in vegan patients (there has been
significant improvement of the condition after multivitamin
supplement administration). Taking all that into account,
further studies are required before indicating the vegetarian
diet for prevention and/or therapeutic purposes.

Concluding, vegetarian diet was associated to lower levels
of TG, TC and LDL as compared to the diet of omnivores.

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References

2. Steinberg D, Gotto AM Jr. Preventing coronary artery disease by lowering
3. Santos RD, Sposito AC, Maranhão RC. Lipidemia pós-prandial e risco de
4. Rizos E, Mikhailidis DP. Are high density lipoprotein (HDL) and triglyceride
5. Centers for Disease Control and Prevention (CDC). Declining prevalence of
no known major risk factors for heart disease and stroke among adults - United
6. Aksah RD, Gower E, Groonl, Rooney BL, Schaper A. Mild hypercholesterolemia
and premature heart disease: do the national criteria underestimate disease
K, et al. Apolipoprotein E epsilon 4 allele, elevated midlife total cholesterol
level, and high midlife systolic blood pressure are independent risks factors
mutation for the secondary prevention of coronary heart disease in men with low
10. Cliffton PM, Nestel PJ. Influence of gender, body mass index, and age response
of plasma lipids to dietary fat plus cholesterol. Atheroscler Thromb. 1992; 12:
693-62.
Moderate alcohol consumption lowers risk factors for cardiovascular disease